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1995

Introduction from *The Changing Prairie: North American Grasslands*

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Joern, Anthony and Keeler, Kathleen H., "Introduction from *The Changing Prairie: North American Grasslands*" (1995). *Faculty Publications in the Biological Sciences*. 291.

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Introduction

Preserving remaining North American grasslands requires a multiability approach. In this book, we investigate three aspects of an admittedly larger problem: (1) how we as humans perceive grasslands; (2) the ecology of grasslands, in order to define the framework within which conservation and preservation efforts must operate; and (3) conservation issues. Additional sociological, economic, philosophical, and cultural considerations will provide important additional insights to preserving and managing grasslands, but are not included here. By restricting our focus to only three issues, we feel that we can provide a basic, but appropriate, understanding of grassland ecosystems for the prairie enthusiast. This provides an essential framework required for what we perceive to be necessary quick action.

PART I: PERCEPTIONS

As humans, we are trapped by our own perceptions and experience of the world, and we act within these constraints. Our first concern in this book is to highlight this issue. We are not in a position to exploit such insights fully and then offer prescriptions for identifying the best approach to describe natural landscapes. However, we feel that it is important that both professionals and lay students think about this problem. These issues are not new. Language is now known to be more than just a vehicle for communication. Our choice of words and metaphors for describing things develops an atmosphere surrounding our subject that limits our intellectual opportunities to investigate the object (Lakoff and Johnson 1980; Hayakawa and Hayakawa 1990). Language often shapes our thinking modes as well as constrains the prescriptions that we offer to solve a problem. In the present context, for example, the phrase “balance of nature” provides a very different investigative framework for grassland study than does “struggle for existence” even though both are routinely used and accurate—even complementary in their own way.

Written impressions of grasslands obtained from well-crafted novels by Willa Cather and Mari Sandoz, or the children’s writer Laura Ingalls Wilder, each written from a pioneer’s perspective, suggest that pioneers and settlers brought order (often through agriculture) to an otherwise unruly natural enterprise. Of course, this is just another view of order. Similarly, others have argued that religious, political, and moral backgrounds shape the metaphors and models that we construct

to describe natural systems and hence subsequent research. These cultural and psychological issues clearly direct our actions toward appreciating and conserving native grasslands.

Olson (Chapter 2) takes a historical perspective to examine culturally dependent, shifting perceptions held by European explorers and settlers toward North American prairie, especially in contrast to the European world that they knew best. This point becomes strikingly evident when European-based views are compared with those of an indigenous native culture, the Lakota. It becomes very clear that the native culture that arose within North American grasslands developed a very different perception of the North American grasslands compared with an overlay derived from a very different European background.

In a modern context, Jacobshagen (Chapter 3) an artist, documents his own visceral feelings toward prairie landscapes. Raised in Kansas, but well schooled in European painting traditions, Jacobshagen examines his own understanding of the dominant horizons and wide-open spaces in which he grew up and which now characterize his own paintings. His artistic impressions provide a clear sense of his creative visions dominated by landscape features truly representative of grassland. By his own admission, academic training within the European traditions channeled his early perceptions of grassland systems. However, it is clear that the plains environment has directed his paintings: light and distance, sky and horizon are dominant themes. We include this chapter to emphasize that different aspects of the environment in the prairies catch the eye than would in forests, for example. This region shapes the reality of its inhabitants.

PART II: GRASSLAND ECOLOGY

At a general level, precipitation, soil characteristics, seasonality, and fire largely drive the emergence of typical grassland characteristics: an abundance of grasses with few or no woody plants. Yet this is an incomplete and unsatisfactory explanation of grassland structure and function. Factors other than just biogeographic considerations contribute to a functioning grassland. Examples arranged in a hierarchical fashion (MacMahon et al. 1978; O'Neill et al. 1986) include (1) the physiological responses of individual plant or animal species to local physical, abiotic conditions; (2) factors influencing population dynamics; (3) interactions among species that dictate population sizes and relative abilities to exist and persist in an area; (4) community-level, multispecies responses to environmental conditions such as changes in resource availability along gradients or frequency and strength of disturbances; and (5) ecosystem-level processes that direct nutrient and energy flow, ultimately contributing to attributes of biomass accumulation.

Traditionally, each of these issues is considered largely independent of the others. Certainly, all contribute importantly and simultaneously to grassland structure and function. This complexity presents a thorny problem to individuals interested in reconstructing the important biological events underlying grassland ecology as well as to those individuals responsible for directing rehabilitation efforts—at the correct level—in order to work within naturally occurring processes. Besides the problems inherent in directing efforts at the correct level in this ecological hierarchy, a similar problem is faced regarding the spatial or temporal scale of the study (O'Neill et al. 1986; Turner 1987; Turner and Gardner 1991). How large an area

for what length of time must be considered in order to include all the component parts and processes that contribute to maintaining grassland structure and function? How big is big enough? How long is long enough?

This is the problem of scale (O'Neill et al. 1986; Turner and Gardner 1991). Scale is a problem that is not particularly well understood at this time in ecological studies, especially for grassland systems. Does understanding detailed processes at the local level allow us to scale up and predict responses of entire watersheds or landscapes, and vice versa? Scale, in an ecological sense, requires that we (1) understand how spatial and temporal boundaries contribute to target problems and (2) understand how ecological processes acting at each level in the hierarchy translate across hierarchical boundaries to affect processes taking place at other levels (O'Neill et al. 1986). This is the problem of scaling up or scaling down, problems still in need of detailed understanding.

In addition to considering scale, heterogeneity must be accommodated (Pickett and White 1985; Kolasa and Pickett 1991). This is particularly important, since realworld heterogeneity can be either stabilizing or destabilizing, depending on the situation or question.

Chapter topics represent each of these different approaches, ranging from basic population processes emphasizing individual, species-specific responses within localized areas to ecosystem-level processes that deal with the flux of matter and energy among whole functional groups. An introduction to each of these topics along with some independent thought and synthesis will provide an excellent scaffold for framing individual questions to our readers.

We asked each contributor to discuss a topic related to his or her research area, drawing generalizations and describing the world as each sees it. We cannot cover all topics, so we asked authors to emphasize new approaches and revised syntheses. As a result, detailed description of prairie vegetation and animals is not included. For the natural history of prairie species—which is fascinating reading—we recommend Roe (1951), Weaver (1954, 1960, 1965, 1968), Costello (1969), Risser et al. (1981), and Runkel and Roosa (1989). This book is not intended as an encyclopedia of prairie biology, but a taste of how our understanding of this dynamic ecosystem is changing.

The field is currently receiving rigorous study, although much remains to be done. Some inconsistencies exist between the present chapters and traditional views of prairie. We have made no attempt to reconcile these differences and, indeed, encouraged them. It is not yet clear whether the differences of opinion are attributable to differences in the ecosystems studied (tallgrass versus shortgrass prairie, Oklahoma versus Colorado) or in the eye or evaluation of the researcher. We do not understand the amount and importance of geographic variation in prairies, although we know that species change across the range of a prairie type (e.g., porcupine-grass dominates eastern sandhills prairie, whereas the closely related needle-and-thread grass dominates western sandhills prairie; compass plant is currently rare to absent in eastern Nebraska prairies; catsclaw sweetbriar is absent from prairies on loess soils). Implications surrounding the variety of responses has rarely been studied. Perhaps we will find that all the published views of prairie are valid, but only for particular prairies at particular times. We hope that inconsistencies will stimulate our readers, when looking at prairies, to evaluate the views for themselves.

Answers to specific problems at actual sites will require detailed understanding of the natural history and ecology of local species. However, important questions can be quickly formulated based on the principles raised in the accompanying chapters. Briefly, Bragg (Chapter 4) describes the prairie vegetation, with emphasis on the current understanding of the role of fire. Perceptions of fire have evolved from being an enemy of preservation to being a widely used tool. Currently, prairie ecologists are considering the complexity of fire: Fires can burn rapidly or slowly, patchily or very completely, relatively hot or warm; and the plants can be stimulated or injured, depending on time of year, soil types, and available water. Equally complex effects are seen on the animal community. Bragg's chapter considers this emerging picture.

Populations consist of groups of potentially interbreeding individuals, a process providing the year-to-year, generation-to-generation continuity. Hartnett and Keeler (Chapter 5) discuss characteristic patterns of population biology of prairie plants and animals. Individual plants and animals interact with dozens of other individuals of the same and different species. These interactions compose the webs of relationships that underlie communities. Joern (Chapter 6) describes representative interactions that develop into the complexity and diversity of the prairie community as we know it.

One of the most difficult problems in prairie ecology concerns understanding of stability and change. Collins and Glenn (Chapter 7) examine this issue head-on. They first discuss the history of the region, including the impacts still evident from the ice ages. They then describe results from their studies illustrating how changeable prairie plant communities are as normal features of natural prairies.

Nearly half the prairie plant occurs belowground as roots; it may be discomforting to some when they realize that we walk across the middle of the plants in our leisurely prairie hikes. Many of the animals—prairie dogs, gophers, mice, ants—live underground. But their impact results from linking significant aboveground and belowground processes, resulting in rich prairie soils. Portions of the Great Plains became the highly productive Corn Belt because of the outstanding quality of the soils. In Chapter 8, Seastedt discusses soil structure and function, drawing attention to the importance and dynamic nature of this often overlooked half of the ecosystem.

PART III: CONSERVATION AND RESTORATION

Certain North American grasslands are clearly under siege. The extreme eastern tallgrass prairie as an integrated ecosystem has ceased to exist. Especially along much of what was previously the Prairie Peninsula, only tiny pieces remain with no significant large vertebrates. Efforts to preserve the tiniest remaining remnants are important, but mostly for educational purposes or to preserve genotypes specifically associated with such environments. Midgrass prairie has largely become wheat fields. At the other extreme, large sections of shortgrass prairie remain, often in good shape or within reach of ready rehabilitation. Possibly because of the large remaining expanses, little threat is seen, although this view is premature (Bock and Bock, Chapter 10).

Few efforts presently exist that are aimed at conserving large tracts to preserve an intact, integrated prairie system that includes the long-range dispersing un-

gulate herbivores. Other systems, such as Nebraska sandhills grassland, retain important large-scale integrity, probably because the sandy soils are not readily tilled and ranchers have largely grazed intelligently. Recent innovations such as center-pivot irrigation have resulted in increasing tilled acreage in many grassland systems, including the sandhills grassland, and will bear close scrutiny for future impacts. Other grasslands illustrate intermediate levels of human impact, but have largely lost key features of an integrated grassland system, mostly because of fragmentation and the missing migrating herbivores.

All chapters bring up important issues dealing with future conservation and restoration needs. In particular, Wallace and Dyer (Chapter 9) and Bock and Bock (Chapter 10) focus on these issues by highlighting the impact of different grazing practices and their consequences for future grassland integrity. We intend this section to be only an opening discussion of the problems of grassland preservation, and many issues are left untouched here. Mostly, an educated and concerned public will provide the energy, interest, and resources to drive serious prairie preservation and rehabilitation. In the process, many new questions will arise, most begging for new insights at both the basic and applied levels. Our goal is to provide a basic foundation in this quest.

THE CHALLENGE AND THE FUTURE

The North American grasslands, especially the tallgrass and midgrass prairies, are among the most completely altered (i.e. destroyed) ecosystems in North America. Furthermore, interest in their preservation is only recently emerging, lagging long behind mountains and seashores.

Grasslands offer a terrific opportunity to develop methods for understanding how an ecosystem can chug along even after it was largely destroyed or to provide a model of ecosystem rehabilitation. The region will continue to be the major site of U.S. food production. In the face of this legitimate human pressure, preserving native species or intact prairie communities, either in preserves or in isolated patches interspersed among cornfields and housing developments, provides a challenge of major proportions. However, such conditions also provide a chance to lead the world in maintaining native species and ecosystems, just as we lead the world in agricultural productivity. All elements of this book are a response to this challenge: how we see the region, how the region functioned before the modern era, and how to integrate sound ecological principles into maintaining regional biodiversity. We must meet this challenge or lose our natural legacy!

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